Milestone: Keeping Time: Homework 2

Due: 4 September 2020

1 Simple vertical sundial

Consider a simple sundial consisting of a vertical stick that casts a shadow. Suppose that one one day the Sun passes directly overhead. On this day sunrise would be at 6:00am and sunset at 6:00pm. The length of the shadow cast by the stick changes during the day.

a) Consider the *change* in length of the shadow from 7:00am to 8:00am versus the *change* in length of the shadow from 10:00am to 11:00am? Would the change in length from 10:00am to 11:00am be smaller than, larger than or the same as that from 7:00am to 8:00am? Explain your answer (a diagram may be useful).

b) Suppose that one tried to record the hours with marks spaced equally distant from each other to indicate the hours. Would this work correctly? Explain your answer.

2 Sundial location

Would a sundial designed to tell time correctly in Grand Junction, CO work equally well if it were moved to Mexico City? Explain your answer.

3 Sundials and ancient society

Ancient Greek and ancient Roman sundials were apparently quite widespread. Barnett claims that, for most ancient Romans, sundials were irrelevant. Why might this have been? To whom would they have been relevant in Roman society?

4 Temporal hours in Fairbanks, AK

The city of Fairbanks, AK is sufficiently far north that its shortest day is much shorter than its longest day. Suppose that the system of temporal hours was used in Fairbanks. For each of the following days determine the duration of one temporal hour.

a) Midwinter, with sunrise at 10:58am and sunset at 2:40pm

b) Midsummer, with sunrise at 2:57am and sunset at 12:47am (the following day).

5 Water clocks versus sundials

One major difference between sundials and water clocks is one of these has moving parts and the other does not. Describe which of these has moving parts and what they are. What issues limit the operation of machines that have moving parts? There is one possibility that applies to nearly any machine that has moving parts. Explain your answer.

6 Ctesibius' water-clock

A typical inflow clepsydra (water-clock) is well suited to measuring time in equal hours and requires little modification to do this. However, Ctesibius went to great lengths to devise a mechanism that ensured that it measured temporal hours.

a) Describe why it was difficult for a typical inflow clepsydra to measure temporal hours.

b) What does the effort that goes into engineering this device say about the importance of temporal hours versus hours that always measure the same amount of time to ancient Greeks? If we were to construct a clock today, would we be inclined to devote any effort to ensuring that it measure temporal hours?